Plate wanting
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AN EXPLANATION OF THE FIGURE OF *ANATOMY*,

WHEREIN
The CIRCULATION of the BLOOD is made viſible thro' Glaſs Veins and Arteries.
WITH
The *Actions* of the *Heart* and *Lungs*.
As alſo,
The COURSE of the BLOOD from the Mother to the Child, and from the Child to the Mother.
By which Means
Any Perſon, tho' unſkill'd in the Knowledge of ANATOMY, may, at one View, be acquainted with the *Circulation* of the *Blood*, and in what Manner it is performed in our living Bodies.
Adorned with a COPPER-PLATE:
WHEREIN
The Structure of the Heart is deſigned, and the Glaſs Veſſels exactly repreſented in their Order, as they are in the Figure to which they are to be referred.

N. B. *This Figure, and ſeveral other curious Anatomical Preparations, are to be Seen at* B. Rackſtrow's *in* Fleet-Street, *at One Shilling each Perſon.*

Printed in the YEAR 1747.

Animadverſion.

AS this Figure is chiefly calculated to demonſtrate the Circulation of the Blood, *with the* Actions *of the* Heart *and* Lungs, *and the Nouriſhment of the* Child *while in the Womb, it was neceſſary that it ſhould repreſent a Woman ſuppoſed to be opened when alive; becauſe theſe are all vital Functions, which are not exerciſed in a Body when dead: Therefore it is to be hoped, that nobody will make Objection to this Repreſentation, which would carry with it an Idea of the higheſt Barbarity and Cruelty, had it ever been put in Practice upon any Human Body.*

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Takes this Method to acquaint the Curious,

THAT he has found out and compleated an Apparatus *to exhibit that grand Experiment,* The Chair of Beatification, *as a Profeſſor of* Wittenburg *in* Germany *has term'd it, with all the other moſt curious and extraordinary Experiments, invented either Abroad or in this Kingdom; with Obſervations on the Power, Activity, Light, Fire, attractive and repulſive Force of* Electricity, *with the inſtantaneous and aſtoniſhing Senſations excited in any Number of Perſons at once; together with his new Experiments relative to the Planetary Syſtem, and the Sun's illuminating the Earth.*

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DESCRIPTION OF THE FIGURE.

THIS Figure repreſents a Woman gone Eight Months with Child, chained down upon a Table, ſuppoſed to be opened alive; of which the two principal Cavities are laid open, *viz.* the Breaſt and the Lower Belly, which are divided from each other by the Diaphragm or Midriff. In the Breaſt, the Heart, which is placed to move for carrying on the Circulation, is ſeen between the two Lobes of the Lungs, which likewiſe move as in Breathing: From the Heart are ſeen going out the two principal Arteries of the Body, made of Glaſs; one leading to the Lungs, and the other towards every Part of the Body, *viz.* towards the Head and Arms, whilſt the Trunk is continued on the Back-Bones through the Breaſt, and, paſſing the Diaphragm into the Lower Belly, divides itſelf to all its Parts, and then goes to the Legs. The ſame Number of Veins made of Glaſs accompany the Arteries, join in one Trunk, and open into the Heart again: Through the Arteries a red Liquor, in Imitation of Blood, is ſeen to move from the Heart to every Part of the Body, and, by the Veins, returning from every Part of the Body to the Heart again. In the Lower Belly, in a Cavity called the *Pelvis* or Baſon; the Child is ſeen in the Womb, with the After-birth and Navel-ſtring made of Glaſs, conſiſting of two Arteries and one Vein ariſing from the After-birth by many Branches, which terminate in one of a conſiderable Length, and enter the Navel of the Child, through which the Blood is ſeen to paſs from the Mother for its Nouriſhment. The two Arteries are likewiſe ſeen to ariſe out of the Navel of the Child, twiſted round the Vein in its Courſe towards the After-birth, where it divides itſelf into a great Number of Branches, in the ſame Manner as the Vein: Thro' theſe Arteries the Blood is likewiſe ſeen to return from the Child to the Mother after Nouriſhment.

Of the Structure of the HEART *and* LUNGS, *and of the Circulation of the* BLOOD.

IN order to have a right Underſtanding of the Circulation of the Blood, it is firſt neceſſary to be acquainted with the Structure of the *Heart* and *Lungs*; becauſe they are the Organs immediately concerned in carrying on that important Function.

Of the HEART.

THE Heart is a ſelf-moving Muſcle, of a pyramidal Figure, ſuſpended (in the Middle of the Breaſt between the two Lobes of the Lungs) by its principal Veſſels, being connected to no other Part, for the Conveniency of its Motions. Of the Heart we may conſider the two Extremities; the one is uppermoſt and broad, called the Baſe; the other is lowermoſt, and, contracting itſelf narrow, becomes a little ſharp, and is called its Point: This is more ſo in Brutes. The Situation of the Heart in Man is reſting on the Diaphragm, ſlanting much towards the left Side, ſo that the greateſt Part of it is placed under the left Breaſt.

IT conſiſts chiefly of four principal Cavities, two of which are called Auricles or Ears, from their Figure, placed on the right and left Sides of the Baſe of the Heart; the two other are the Ventricles, which are Cavities formed immediately in the Subſtance of the Heart: The one is the Right Ventricle, and the other the Left: The right Ear opens into the right Ventricle, and the left Ear into the left Ventricle. The Heart, like all other Muſcles, is made up of a great Number of Fibres or fleſhy Threads, diſpoſed in a particular Manner, on the Inſide of the Ears, where they form a kind of irregular Network; and in the Ventricles, beſides this Network, ſeveral conſiderable Eminences called Pillars. The right Ear opens into the right Ventricle, and the left into the left Ventricle: At the Entrance of the right Ear into the right Ventricle; there are placed three Valves, which open from the right Ear into the right Ventricle, but cloſe the Return from that Ventricle into that Ear: From the left

Ear into the left Ventricle there are placed two more, in the ſame Manner as in the right Ventricle.

THERE are four principal Veſſels which come into and go out of the Heart; two Veins and two Arteries: The two Veins are the *Vena Cava*, or hollow Vein, which is made from the Union of all the Veins of the Body, and the Pulmonary Vein, made from the Union of all the Veins of the Lungs. The *Vena Cava* opens into the right Ear, and the Pulmonary Vein into the left. The two Arteries are, the Pulmonary Artery, which divides itſelf into every Part of the Lungs, and the *Aorta Magna*, or great Artery, which divides itſelf into every Part of the Body: The Pulmonary Arteries ariſe out of the right Ventricle, at the Beginning of which there are placed three Valves in the Figure of a Half-moon, which open from the Ventricle into this Artery, but cloſe from the Artery into the Ventricle: The *Aorta Magna*, or great Artery, ariſes out of the left Ventricle, at the Entrance of which there are placed three other Valves of the Half-moon Form, diſpoſed in the ſame Manner as thoſe in the Pulmonary Artery. Beſides theſe principal Veſſels, there are two Arteries and a Vein appropriated to the Uſe of the Heart; the Arteries are called Coronary; they ariſe from the great Artery at its going out of the Heart, and are diſtributed throughout the whole Subſtance of the Heart for its Nouriſhment; and the Veins bear the ſame Name, which return the Blood into the right Ear.

Of the LUNGS.

THE Lungs are two in Number, ſituate on each Side of the Heart, of an elaſtic ſpungy Texture: They are connected to the Veſſels of the Heart and Windpipe, of which they are chiefly compoſed.

The

The Windpipe is the Paſſage for Air into the Lungs only: Its upper Part is made up of five ſmall Cartilages, or Griſtles, four of which form its Entrance, which is at the Root of the Tongue, before the Entrance of the Gullet, and is the Paſſage for the Aliments. The fifth is a cartilaginous Valve placed at the Entrance of the Windpipe, which is preſſed down at the Time the Aliments are paſſing into the Gullet. The Windpipe is compoſed of many cartilaginous Rings, looſely connected to each other, in ſuch manner that they may draw one in another: It is placed in the Fore-part of the Neck, and, after its Entrance into the Breaſt, divides itſelf into two Branches, whereof one enters the right Lobe of the Lungs, and the other the left: Theſe Branches divide themſelves throughout the whole Structure of the Lungs, and every-where terminate in ſmall Veſicles or Bladders, which are all tied together by a Number of ſmall Productions from the common Covering of the Lungs. The next Veſſels are the Pulmonary Arteries and Veins: The Pulmonary Artery divides itſelf above the Heart into two Branches, one to the right, the other to the left Lobe of the Lungs, where they follow all the Diviſions of the Branches of the Windpipe, lying on the Sides of them, and continuing their Courſe till they have attained to the ſmall Veſicles, where they ſpread themſelves over them in a Number of ſmall capillary Veſſels. From theſe ſmall capillary Arteries on the Veſicles ariſe the capillary-pulmonary Veins, which, uniting themſelves from ſmall Branches into large, on the Sides of the Branches of the Windpipe, form one Trunk in the left Ear. As theſe conſiderable Veſſels conduce nothing to the Nouriſhment of the Subſtance of the Lungs (as will more particularly be treated of in deſcribing the Circulation of the Blood in the Child while in the Womb), there is a particular Artery for that Uſe, called the Bronchial Artery, and a Vein to return the Blood.

Of the CIRCULATION *of the* BLOOD, *and its Uſe.*

FROM what hath been ſaid of the Structure of the Heart, and the Diſpoſition of its Veſſels and Valves, placed at the coming in of the Ventricles from the Ears, as well as of thoſe placed at the going out of the Ventricles into the Arteries; if the Action of the Heart be rightly conſidered, its Uſe may be eaſily underſtood; for the Ears and Ventricles have both of them the Power of contracting and dilating themſelves: But neither of theſe two Actions can happen at the ſame Time both in the Ears and Ventricles; but the Dilatation of the one muſt ſucceed the Contraction of the other, for Reaſons now to be mentioned: For the Blood is always flowing from the *Vena Cava* into the right Ear, and from the Pulmonary Vein into the left, the one from every Part of the Body, and the other from the Lungs: So that the Ears, if rightly conſidered, are two little Reſervoirs, always ready to ſupply the Ventricles with a menſurated Quantity of Blood, leſt its Motion ſhould be ſuffocated by the Weight of too much Blood at one Time. As to the Ventricles, they are to receive the Blood from the Ears, in given Quantities, in order to force it out of their Cavities into the Arteries, by the Force of the right Ventricle through the Pulmonary Artery into the Lungs, and by the left through the great Artery into every Part of the Body. When the Ears contract, the Ventricles dilate, becauſe that the Ventricles, at that Time, are receiving the Blood from them; and, when the Ventricles contract, the Ears dilate, becauſe,

becauſe, at that Time, the Blood, endeavouring to return into the Auricles from the Ventricles, preſſes againſt the Valves, and cloſes them; during which Time the Auricles are filling, and kept dilated: The Blood in the Ventricles, which cannot return into the Auricles, is forced over the Half-moon Valves into the Pulmonary Artery from the right Ventricle, as well as over thoſe from the left Ventricle into the great Artery, by which Means the Arteries are dilated and filled with Blood: So that the Dilatation of the Arteries ſucceeds the Contraction of the Ventricles; for no Blood can return from the Arteries into the Ventricles, becauſe the Half-moon Valves ſhut up the Mouths of thoſe Arteries, whenever the Blood endeavours to return; and this is the Reaſon of the Pulſation of the Arteries. Hence it plainly appears, that the Uſe of the Heart is to carry on two Circulations of the whole Maſs of Blood at one and the ſame Time; the one from the right Ventricle through the Lungs to the left Ear, and the other from the left Ventricle through every Part of the Body to the right Ear. The Manner in which theſe Circulations are carried on, is the next Thing to be conſidered: And firſt, of that through the Lungs.

THE Lungs perform two Actions; that of Inſpiration, and that of Expiration: The firſt is when the Air is taken into the Lungs, and the other is when it is thruſt out.

THE firſt Action is performed by the Means of many Muſcles, which raiſe the Ribs, and widen the Breaſt; during which Time the Midriff, from a convex Surface towards the Breaſt, becomes plane; and at the ſame Time the outward Air, being preſſed, ruſhes in at the Noſe and Mouth, and paſſes through all the Branches of the Windpipe, which lead to the ſmall Veſicles, by which they are blown up. The Rings which compoſe the Branches of the Windpipe, which before were contracted one within another, are now extended the one from the other; the Branches of the Pulmonary Artery and Vein, lying on the Sides of the Branches of the Windpipe, muſt, of Neceſſity, be co-equally extended with them, which before lay in Folds, gives now to the Blood a free Opportunity to paſs from the right Ventricle of the Heart, through all the Ramifications of the Pulmonary Artery, and fill their Capillaries, which are diſtributed on the Veſicles: By this Time the Elevation of the Ribs ceaſes, and the Antagoniſt Muſcles pull them down, aſſiſted by the Weight of the external Air, which preſſes on their Surface, drives the Air violently out of the Veſicles thro' all the Branches of the Windpipe; and their Sides being brought together, the Blood contained in the Capillary Arteries by this great Preſſure is broken, and its Globules grown ſo ſmall, as to be able to paſs in the Capillary Veins, which are the Pulmonary Veins, from whence it is propell'd, by the continual Contraction of the Lungs, into the left Auricle of the Heart.

HENCE we find the great Neceſſity of Reſpiration; for by it the Blood, in its Paſſage through the Lungs, undergoes a violent Trituration, breaking the Texture of its Globules to ſeparate its Parts, by which Means they become diſſimilar to each other, and prepare a ſufficient Quantity of different Particles, for the Nouriſhment of the different Parts of the Body, which is carried on by the ſecond Circulation from the left Ventricle of the Heart thro' the *Aorta Magna*, or great Artery.

THE left Ventricle of the Heart has its Sides about four times as thick as the right; and neceſſary it was it ſhould be ſo; a greater Force being required to drive the Blood thro' the great Artery into every Part of the Body, than thro' the Lungs only, which is the Uſe of the right Ventricle.

The *Aorta Magna*, or great Artery, is an elaſtic cartilaginous Tube ariſing out of the left Ventricle of the Heart, and divides itſelf to every Part of the Body, the Branches of which continue their Diviſion till they become ſo ſmall as to be as fine as a Hair, and are call'd Capillaries: From theſe ſmall Capillary Arterties ariſe another Kind of ſmall Veſſels, which are called Veins, which frequently unite into larger Branches from every Part of the Body, till they have formed one common great Trunk, called the *Vena Cava*, or great hollow Vein, which opens itſelf into the right Ear of the Heart. The Blood, which has been ſufficiently ground and ſubtilized by the Action of the Lungs, as was now mentioned, is brought into the left Ear by the Pulmonary Veins. The Cavity of each Ear is capable of containing one Ounce of Blood; ſo that whenever the left Ear contracts, the great Artery muſt receive one Ounce of Blood, becauſe the left Ventricle can throw no more Blood into the great Artery than what it receives from its Ear. During the Time the great Artery is receiving this Quantity of Blood from the contracting Ventricle, it is much dilated or ſtretched: But, as its Subſtance is endued with a great Spring, as ſoon as the Reſiſtance is taken off, which is, when the left Ventricle dilates to receive a freſh Quantity of Blood from the left Ear, then the Artery contracts itſelf; by which Means the Blood is crouded into its Cavity, and cloſely embraced and preſſed againſt its Sides; the Blood, at the ſame Time, equally reſiſting every Way, preſſes againſt the Half-moon Valves, and prevents its Return into the left Ventricle, and thus is obliged to paſs on thro' all the Ramifications of this Artery into every Part of the Body.

During the Time that the Artery is contracting to propel the Blood into every Part of the Body, the left Ventricle is dilating to receive another Quantity of Blood from the left Ear, in order to throw it into the great Artery again, by the Time that the Contraction of its Sides are over.

Thus by the alternate Dilatation and Contraction of the left Auricle and left Ventricle, the Blood, which returns from the Lungs, where it has been attenuated and rendered fit for the Nouriſhment of the different Parts of the Body, is ſent by the great Artery to be diſtributed to them, whilſt the excrementitious Parts are ſtrained off by particular Glands, and carried out of the Body by Sweat, and other Evacuations: The remaining Part of the Blood, which has not been ſufficiently ground by the Action of the Lungs, is taken up by the Veins, and brought back to the *Cava*, to be poured by the right Auricle into the right Ventricle, in order to be forced thro' the Lungs again, and there to undergo another Trituration, and afterwards to be diſtributed to every Part of the Body again, in the Manner it has already been deſcribed.

Of the NOURISHMENT *of the* CHILD *in the* WOMB.

During the Time that the Child is in the Womb, it is nouriſhed with Blood only, brought to it from the *Placenta*, or After-birth, through the Navel, by the umbilical Rope or Navel-ſtring; but, as there is always more Blood convey'd to it, than is neceſſary for its Nouriſhment, there is a conſtant Return of this Blood through the Navel-ſtring to the After-birth again.

Therefore,

Therefore, to have a right Underſtanding in what Manner this reciprocal Circulation is carried on, it is neceſſary to conſider the Child, during the Time it is in the Womb, to be precluded from all Communication with the outward Air, and cannot breathe, all the Veſicles or little Bladders of its Lungs being cloſely preſſed together, and the Extremities of the Pulmonary Arteries and Veins equally preſſed with them, ſo that the Courſe of the Blood thro' the Lungs is intirely ſtopt till the Birth; and, notwithſtanding, that the Circulation of the Blood may be conveniently carried on (there are particular Paſſages left open) without ever paſſing thro' the Lungs.

THE firſt of theſe Paſſages is called *Foramen Ovale*, which is an oval Hole opening from the right Ear of the Heart into the left, where there is a Valve ſhutting from the left Ear into the right. The ſecond is a Canal of Communication, called *Ductus Arterioſus*, which, from the Trunk of the Pulmonary Artery, opens into the Trunk of the *Aorta Magna*, or great Artery.

THE *Placenta*, or After-birth, is a large Maſs of Blood-Veſſels, like a Cake, compoſed of Arteries and Veins, by the Extremities of which it is faſten'd to the inward Surface of the Womb, ſo that the Extremities of the Arteries of the Womb are joined to thoſe of the Veins of the *Placenta*, and the Extremities of the Arteries of the *Placenta*, to thoſe of the Veins of the Womb; by which Means the maternal Blood, by the Arteries of the Womb, is tranſmitted into the Veins of the *Placenta*, which Veins unite into one conſiderable one in the Middle of the *Placenta*, about an Ell long, which enters the Navel of the Child, paſſing through the Fiſſure of the Liver, and opens in the *Vena Cava*, to bring the Blood into the right Ear: One Part of this Blood paſſes through the *Foramen Ovale*, or oval Hole, into the left Ear; the two Ears, contracting themſelves, force the Blood in the right and left Ventricle of the Heart, ſo that the Blood contained in the left Ventricle is forced up the great Artery, and that in the right up the Pulmonary: This Blood, finding no Paſſage through the Lungs, paſſes the Canal of Communication, and mixes itſelf with the Blood of the left Ventricle in the great Artery, by which it is ſent to every Part of the Body of the Child for its Nouriſhment: The remaining Quantity of Blood, which is not employ'd in nouriſhing the Child, returns by two Arteries, which come out at the Navel of the Child, and are convoluted about the Vein, which three Veſſels compoſe the Navel-ſtring. The Arteries, having reach'd the After-birth, divide into an infinite Number of Ramifications, whoſe ſmalleſt Branches unload themſelves of their Blood into the Veins of the Womb of the Mother. Thus the Child is continually nouriſhed during the Time that it is contained in the Womb, and the Circulation carried on without ever paſſing through the Lungs.

But, after the Child is born, the Air, finding a Paſſage into its Lungs, blows up all the Veſicles; by which means the Preſſure is taken off from the Blood-Veſſels; at which Time the Blood in the right Ventricle, finding a free Paſſage through the Pulmonary Artery into the Lungs, paſſes no more through the Duct of Communication, but returns, by the Pulmonary Vein, into the left, and, beating againſt the Valve of the *Foramen Ovale*, for ever cloſes it up.

An EXPLANATION of the PLATE, which ſhews the Glaſſes, with the Heart and Windpipe, as they are ranged in the Figure.

A *The Point of the Heart.* B *Its Baſe.*
C *The right Ear.*
D *The left Ear.*
E *The right Ventricle.* e e e *Three Valves.*
F *The left Ventricle.* f f *Two Valves.*
H *The Windpipe.* h *Its Diviſion.*
i i i i *Some few of the Veſicles at the End of the Branches of the Windpipe.*
G *The Pulmonary Artery.* g g g *Three Valves.*
* *Its Diviſion to the Lungs.*
I I *The Pulmonary Veins, their Union into the left Ear.*
K *The* Aorta, *or great Artery.*
l l l l *Its Diviſion to the Head and Arms.*
L *The Trunk of the great Artery continued downwards.*
m m *Branches to the Kidney.*
n *Diviſion of the great Artery to the Legs.*
o o o o *The Veins returning from every Part of the Body into* P P *the* Vena Cava, *or great Trunk, where all the Veins unite in the right Ear.*

Note, *The* Darts *repreſent the Courſe of the Blood circulating through the Heart and Lungs, as well as to and from every Part of the Body. Where the Points of the* Darts *are directed from the Heart, they ſhew the Courſe of the Blood in the Arteries; and where they are directed to the Heart, they ſhew the Courſe of the Blood in the Veins.*

F I N I S.